

# Greywater Treatment Using Wetland: A Review

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**ABSTRACT:**The water usually from the shower, sinks and bathroom are called “gray water”. This greywater with appropriate treatment can be used for irrigation which enables residential and the backyard gardens to reconnect to the natural water cycle. A treatment which has proved to be very efficient in recycling Greywater is “Root zone”. This paper emphasis on the study of the effectiveness that wetland plant *Colocasia esculenta* and *Canaindica* have on the treatment of Greywater with the help of horizontal subsurface flow root zone system. A flow reed bed of size 0.6 X 0.4 X 0.3m was constructed, in which the media consisting of coarse aggregate, fine sand, black cotton soil were used. The flow rate at which the system was fed was 3 litres/day. The process of adsorption takes place, which is further followed by filtration, which is eventually followed by root zone treatment. Periodic collections of the raw greywater and treated Greywater were done to enable quality testing using standard methods. The reed bed unit is found to be reducing the concentrations of TSS, TDS, BOD, COD by 63%, 79%, 86%, 53% respectively on an average. This treated Greywater can be utilized for gardening and for flushing the water closet.

**KEYWORDS:**Grey water, Treatment, wetland plant, *Colocasia esculenta*, *Canaindica*.

## I. INTRODUCTION

Water scarcity has emerged as one of the most pressing problems in the 21st century. It is estimated that 2.7 billion people will face water scarcity by 2025 (UN, 2003). In India, it is predicted that one person in three will live in conditions of absolute water scarcity by 2025 (IWMI, 2003). In India per capita yearly surface water availability in the years 1991 and 2001 were 2300 m<sup>3</sup> (6.3 m<sup>3</sup>/day) and 1980 m<sup>3</sup> (5.7 m<sup>3</sup>/day) respectively, and these are projected to reduce to 1401 m<sup>3</sup> and 1191 m<sup>3</sup> by the years 2025 and 2050 (Kumar et al., 2005).

Total water requirement of the country in 2050 is estimated to be 1450 km<sup>3</sup> which is higher than the current availability of 1086 km<sup>3</sup>. So, to reduce the demand of fresh water we have made to attempt to make the utilize of grey water. Greywater is wastewater, including water from hand basun, bath shower, dishwashing, washing machine, kitchen sink. In the total wastewater grey water generates 50-80%. Out of total greywater, bathing water generates 50-60%, Water generates from hand washing & Cloth washing is 25-35%, Kitchen water generates 10%. Shampoo, laundry powder, hair, dirt, soap, toothpaste are the waste included in freshwater (Kate and Kumbhar 2017). pH, COD, BOD, Turbidity, Total solids and Conductivity are the parameters of greywater. It is consider low strength, high volume waste water with high potential for reuse and application (Michael Otengpeprah et al 2018). It is necessary to Reuse of greywater in water stressed areas. So, to treat greywater we can use the Root Zone technology (Kate et al. 2020)...Root zone technology is natural & green technology in which biological activity takes place through different types of microbes, the root of plants, water, soil & sun (Kate and Kumbhar 2017).

The bed consists of different bed layers containing coarse aggregates, fine sand & soil. This method uses natural method for treating domestic & industrial effluents. This method makes use of biological & physical treatment processes to remove pollutants from wastewater. This method do not require any chemicals, mechanical pumps or external energy. This method reduces cost of construction as well as maintenance cost (Kate et al. 2018).. This method do not require any pipe connections over longer distances. It is useful for treating non point sources effluents. Decentralized wastewater systems was developed in Germany and slowly it is gaining importance as it is cost-effective and is useful to overcome scarcity of water.

## II. LITERATURE REVIEW

Kadriye Oktor et. al. studies “Treatment of wash basin and bathroom greywater with *Chlorella variabilis*”. They investigates behavior of light grey-water with *Chlorella variabilis* and separately collect samples from wash basin and



bathroom. Then, centrifuge to remove the suspended solids and *Chlorella variabilis*. They calculate, removal efficiencies of BOD5, COD, TP, and TN, which is observed upto 91.9% ,92.3%, 85.6%, BOD5, COD, TN and >97% TP remediation. Finally, confirms this water can able to reuse for toilet flushing.

Snigdhendubala Pradhan et. al. working on “Greywater treatment by ornamental plants and media for an integrated green wall system”. It reveals, in natural treatment systems a complex interactions between the microbes, media, plant roots and greywater. The system removed hydrophilic and hydrophobic compounds. For onsite metropolitan greywater treatment the implanted vertical walls are more capable technology.

Chloe Rose Bolton et. al. studied “Development of an integrated wetland microbial fuel cell and sand filtration system for greywater treatment”. Present study increases attention towards design of a system Bio-sand filter and constructed wetland (CW) microbial fuel cell (MFC) for reuse of hand-washing greywater and generate bioelectricity. In this system to removed 4-log E. coli load, 99% of COD and achieved a 432mgL-1 organic load. The system of CW-MFC and BSF are potentially profitable and sustainable. They find efficient method for disinfection of sample (hand-washing greywater) and to improve good power generation system.

G Baskar et. al. working on “Root zone technology for campus waste water treatment”. The main aim of this work is to effective study of wetland plant (*Phragmites australis*) in treatment of raw water generated in University. Wetland system is most effective treatment of wastewater. To construct the pilot wetland unit in appropriate size in ground and collect wastewater from campus. The various taste are conducted to decreasing concentration like COD, BOD, TDS,TP, TSS etc. and compare the result of conventional treatment. It conclude that, the root zone techniques are conventional treatment for wastewater treatment.

M. Preethi Abinaya et. al. studied “Reuse of Grey Water using Modified Root Zone System”. In the treatment of Grey water the usefulness of the wetland plant *Colocasia esculenta* and waste biomass were investigate using horizontal subsurface flow root zone system. The collected raw gray water and treated gray water verified for superiority by standard methods and results shows, reed bed unit is decreasing the concentrations of COD,TDS,BOD,TSS by 53 % ,79% , 86%, 63% resp. After the treated Greywater can be used for flushing and gardening.

Veljko Prodonovic et. al. studies “Green walls for greywater reuse : understanding the role of media on pollutant removal ” In this study of evaluated potential media for their purpose of greywater recycling vegetated walls . and examined procedure of pollutant remove in greywater . In this 8 potential media ,pertile and coco coir have more potential to remove pollutants capacity from greywater . slow media indicates higher pollutant remove capacity than fast media . averaging around TSS -90% ,Total Nitrogen -50%, TP – 30%, COD -70%, E-Coli 80%, respectively. It concludes that pertile and coco coir are best option to remove pollutant removal and green walls are more effective for greywater reuse .

Som Godfrey et. al. studied “ Greywater reuse in residential schools in Madhya Pradesh , India -A case study of cost – benefit analysis ” In this case study finding cost benefit analysis of greywater reused . In Madhya Pradesh school greywater treatment plant designed and reuse for different purposes. This study indicates that external and internal benefit are exceed than the external and internal cost . In short benefit higher than the cost . To finding CBA Govt. of MP has allowcated money/ funds for to developed or constructions of 412 greywater system. In these 200 system are already constructed in residential schools .

### III. MATERIALS AND METHOD

#### 1. DESIGN OF WETLAND UNIT:

As per the Indian standard, the domestic water supply is required for average Indian city is 135 lpcd and after utilization water generates 80% greywater wastewater, which includes 70% of greywater . for the design of wetland unit 70% of of greywater generated is consider.

$Q_s = 135 \text{ lpcd} = \text{Domestic water supply.}$

$Q_w = 80\% \text{ of } Q_s = \text{waste water generated .}$

$Q_w = 80/100 \times 135 = 108 \text{ lpcd.}$

$Q_d = 70\% \text{ of } Q_w = \text{Grey water generated .....( assumed )}$

$Q_d = 70/100 \times 108 = 75.6 \text{ lpcd}$

Design flow

$Q_d = 0.0756 \text{ cub.m/day/person}$

In each flat 4 person are consider

$Q_d = 0.0756 \times 4 = 0.30 \text{ cub.m /day}$

Hydraulic conductivity = 259 cub.m/ day / sq.m

Hydraulic gradient = 0.01 ( assumed ).

cross- sectional area =  $Q/k_{ss} = 0.30/ 259 \times 0.01 = 0.12 \text{ sq.m}$

Assume depth (d) = 0.3 m

Bed width ( w ) = area / depth = 0.12/0.3 =0.4 m

Length = 1.5 X 0.4 =0.6m

The design of wetland unit is 0.6m long 0.4m wide and 0.3m deep, with 2 plant i.e. Colocassia and canaindica can treat greywater generated by 4 person at initial stage of construction and after 10 to 15 days ,1 plant could treat greywater generated by 4 people , the root network spread wider .

2. CONSTRUCTION AND WORKING OF ROOT ZONE TECHNIQUE :

For the remediation of greywater generated at domestic level an artificial sub- surface flow wet land is constructed.

Four chambered treatment process is incorporated as an assembly of drums and pipe networks .

- Settling tank = The unit consist of settling tank and use of opaque plastic drum where gray water from building kitchen, sinks, bathroom, cloths washing is collected .The grey water is allowed to remain still so as to settle down the large particle in forming sludge the duration for settlement of particles is 24 hrs . After 24 hrs , water is release in wetland unit by use of pipe network .

- Wetland unit = It consists three layers of different materials .

- Coarse aggregate : It is the first layer in the wetland unit from bottom. 20mm size of aggregates are used.

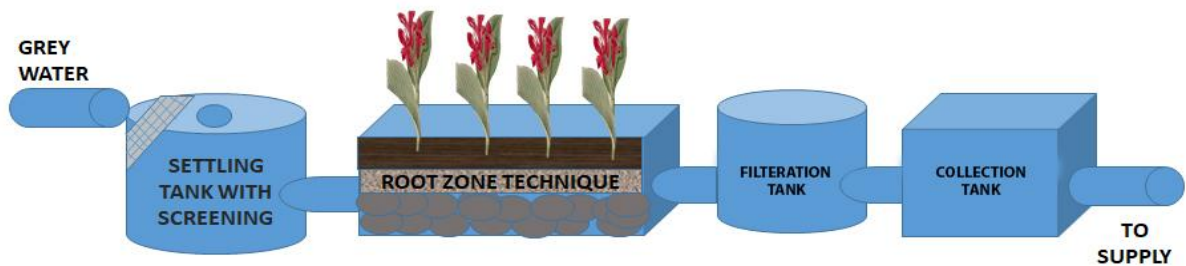
- Fine aggregate : It is the middle layer in wetland unit .

- Soil: It is the top layer in wetland unit. black cotton soil is used

- After arranging the layer canaindica and colocasia are planted alternatively.

- Filtration tank = Then water is released into filtration tank after 24 hrs the media of fine sand, moist wood chips, cheese cloth and soil accordingly. Filtered greywater passes from it. The greywater passes through the filtration unit slowly and then clean water exits the system through hole opening at the bottom of the container.

- Collection tank = water after filtration is realeased into the collection tank.



**GREYWATER TREATMENT PLANT**

Figure 1 Grey water treatment plant

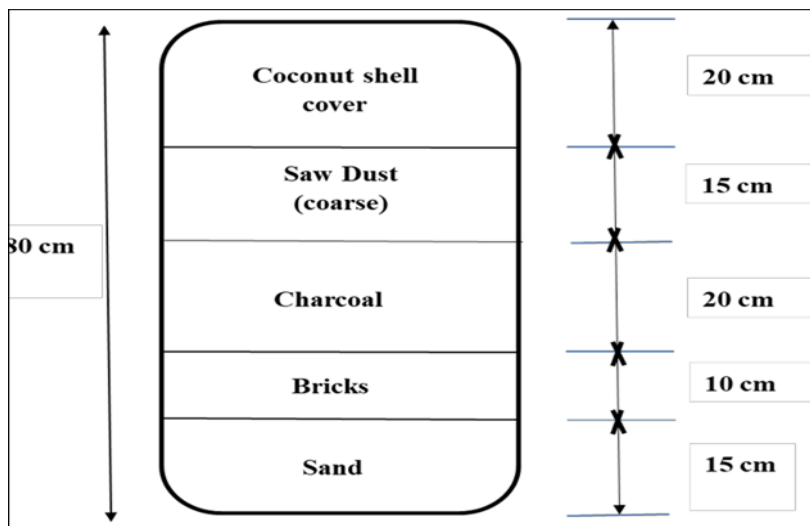


Figure 2 Laboratory scale greywater treatment system - Filter media

The treated sample was collected and were immediately transported to environmental engineering laboratory for testing . The collected water contains larger particles in water which were were settled down in sedimentation tank and media of filtration tank which was characterize by reduction of BOD , absorption of colours , sand filter were also used in reducing organic pollutants Greywater characteristics parameters BOD, COD, Turbidity, Suspended solids , DO , these samples were analysed using method of wetland analysis . This treated water is used in irrigation and flushing gardening and other various purposes.

#### IV. CONCLUSION

Analysis of Greywater was done to determine its characteristics . The modified root zone method (constructed wetland ) to treat the Greywater was scaled so as to be implemented in the lab . This study ensured that the designed subsurface horizontal flow constructed wetland system is effective in the treatment of Greywater. A constructed wetland system also enables re-usability. A constructed root zone system is less operating cost , less maintenance cost , high effective purification hence , this concluded that wetland treatment is more effective than another natural treatment methods.

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